

ACKNOWLEDGMENTS

Field support was provided by National Science Foundation grant GB-22645, and publication costs were partially provided by BMS 75-13063. We are grateful to C. Rose Broome for her comments upon the manuscript.

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FOUR NEW SPECIES OF CENTAURIUM (GENTIANACEAE) FROM MEXICO

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Work on a taxonomic revision of the New World members of *Centaurium* (Gentianaceae) has resulted in the recognition of four previously undescribed species from Mexico. Three are known to me only from herbarium specimens, but living material of a fourth has been collected and observed.

Centaurium gentryi Broome, sp. nov. Herba annua parva caule simplici ramis paucis, rosula basali, foliis caulinis setaceis, et floribus paucis pentameris lobis corollae tubo longioribus. A *C. madrensi* foliis basalis multo majoribus persistentibus, nodis caulinis foliosis paucioribus, floribus majoribus differt. Fig. 1a, b.

TYPE: Mexico, Chihuahua, Rancho Byerly, Sierra Charuco (approx. 27°30'N, 108°40'W), on rocky igneous slopes in pine-oak forest, 1525–1770 m, 17–25 Apr 1948, *Gentry 8035* (Holotype: UC; isotypes: DS, MEXU, MICH, US).

Plants annual with erect simple stems 11–26 cm tall, branched mostly above the middle with only ca 3 elongate internodes, 10–55 mm long, beneath the first branch. Leaves strongly dimorphic, the basal 3–6 pairs in a rosette, these lance-ovate to broadly ovate, 5–12 mm long, 3–6 mm broad, the cauline leaves linear or subulate, 3–12 mm long and 0.5–1 mm broad, appressed to the stem. Inflorescence a simple paniculate or racemose cyme, sparingly branched, with the branches ascending at angles of 20–30° from the main axis, often uniflorous; pedicels of central flowers in a dichasium 46–56 mm long, but as short as 6 mm on lateral flowers. Flowers pentamerous, usually 1–6 per plant. Calyx 4.5–9.2 mm long, the lobes 4.2–8.7 mm long, subulate-attenuate and moderately keeled, without prominent hyaline margins, about equally the corolla-tube. Corolla vivid rose-pink without a prominent white eye, (11–) 18–22.5 mm long; corolla-tube (4–) 7–8.2 mm long, not constricted above ovary, the top slightly flared into a throat; corolla-lobes (7–) 12–15 mm long, (3.5–) 5.5–6.5 mm broad, lance-ovate, obtuse at tips. Stamens 4.5–7 mm long, inserted just below summit of ovary, shorter than or equalling style at anthesis; anthers linear before anthesis, 1.2–2 mm long when coiled; pollen grains 23.8–40.8 μm in diameter. Ovary 4.2–7.5 mm long at anthesis; style exerted, 4.6–7 mm long, the stigma bilobed with lobes slightly broader than long. Capsule oblong, not resinous, ca 8 mm long and 3 mm broad; seeds reddish-brown, 0.3 mm long.

The Rio Mayo region of western Mexico has yielded a number of plant novelties, but the area has been little collected since Gentry's expeditions in the 1930s and 1940s. This very distinctive Rio Mayo *Centaurium* is accorded the rank of species, in spite of the fact that it is known only from a single collection. Its large, showy flowers with long exerted styles are reminiscent of those of *C. chironioides* (Griseb.) Druce, but in its habit, inflorescence, and leaf morphology it more resembles *C. madrense* (Hemsley) B. L. Robinson, a species of the Sierran region of Sinaloa, Durango, Nayarit, and Jalisco. It is probably more allied to those two Mexican species than to the *C. calycosum* (Buckley) Fern. complex of the United States and bordering states of Mexico. It differs from *C. madrense* by having much larger basal leaves, fewer leaf-bearing nodes beneath the inflorescence, broader and shorter calyx-lobes, and conspicuously larger corollas.



FIG. 1. *Centaurium gentryi*, a. habit (x0.5), b. flower (x1.2)—based on *Gentry 8035*; and *C. pterocaula*, c. habit (x0.3), d. flower (x1.2)—based on *Smith M81*.

***Centaurium pterocaula* Broome, sp. nov.** Herba annua, caule erecto alato, floribus paucis pentameris magnis, lobis corollae tubo longioribus. *Centaurio chironioides* affinis, caule et videtur simplici, alis usque ad 1 mm latis, undulatis, foliis inferioribus obovatis latoribus differt. Fig. 1c, d.

TYPE: Mexico, Hidalgo, Zimapan, *Coulter 941* (Holotype: K; isotype: GH).

Plants annual with erect, simple stems 23–39 cm tall, relatively stout and prominently 4-winged, the wings on the lower stem ca 1 mm wide and ruffled. Leaves cauline, 9–33 mm long, 6–13 mm wide, obovate, obscurely 3-nerved, obtuse-tipped at lower nodes, and becoming narrower and shorter upwards, narrowly obovate to oblanceolate with acute or acuminate tips, reduced to lanceolate bracts in the inflorescence. Stem-

wings and leaf margins blue-black upon drying. Inflorescence a simple determinate panicle with both dichasial and monochasial branching, the branches up to 20 cm long and leafy, only once or twice compound or uniflorous; pedicel of central flower of a dichasium 6–17 mm long, but as short as 2 mm on lateral flowers. Flowers pentamerous, showy, usually 4–10 per plant. Calyx 6–8 mm long, the lobes 4–5.5 mm long, narrowly triangular-attenuate to narrowly subulate-acuminate, about equally the corolla-tube, the hyaline margins narrow. Corolla apparently deep rose without white eye, 16–23 mm long; corolla-tube 6–9 mm long, slightly exceeding and constricted above the ovary; corolla-lobes 10–14 mm long, 4–7.5 mm wide, ovate or lance-ovate with acute or slightly acuminate tips. Stamens 4.5–5.5 mm long, inserted in corolla-tube just below the summit of the ovary and nearly equalling the style at anthesis; anthers linear-oblong before anthesis, 1.6–2.2 mm long when coiled; pollen grains 26.6–29.4 μm (Carlson 3148) or 33.9–46.2 μm (Smith M81) in diameter. Ovary oblong, thick-walled, ca 7–7.5 mm long; style exerted from corolla-tube, 5–7 mm long, the stigma bilobed with lobes slightly broader than long. Mature capsule not seen; partially mature one 7.6 mm long and 3.4 mm broad, oval with rounded apex; seeds not seen.

Mexico, in states of Morelos, Hidalgo, and San Luis Potosí, in montane pine forests at 1800–2500 m. Flowering specimens have been collected in January and April.

Additional Collections: MEXICO. MORELOS: in pine forest on Old Mexico City Highway, 16 Apr 1960, Smith M81 (TEX); between Cuernavaca and Mexico City on old road, km 62, 2070 m, 27 Jan 1955, Carlson 3148 (DUKE). SAN LUIS POTOSÍ: Cerro de la Silleta, near Xilitla, Paray 369 (MEXU).

Considerable variation exists among the four collections that I have included in this taxon. The Carlson specimen has strikingly large, broadly obovate leaves at the lower nodes reminiscent of *Schultesia lisianthoides* (Griseb.) Benth. & Hook. ex Hemsley or *Centaurium strictum* (Schiede) Druce. The broad lower leaves are absent in Coulter 941 and Smith M81. The inflorescence is narrowest and shortest in Carlson 3148, but more open and divaricate with few branches in the other specimens. All specimens share the distinctive characters of the broad stem-wings, sharply keeled calyx-lobes, and large flowers. They also display a bluish color in the vegetative organs similar to that found in *C. chironioides* and *C. pauciflorum* (Mart. & Galeotti) B. L. Robinson, two other Mexican species probably closely related to *C. pterocaulis*.

The occurrence of these few specimens over so wide a geographic range within central Mexico suggests a species which at an earlier time has been more abundant. Undoubtedly the widespread destruction of forests in this most populated area of Mexico has drastically reduced the populations of this species. My several searches from 1969 to 1975 were unsuccessful.

Centaurium wigginsii Broome, sp. nov. Herba annua caule simplici foliis caulinis obovatis oblongis decussatis, ramis divaricatis superne, floribus parvis pentameris roseis. *Centaurio stricto* ubique affinis, sed inflorescentia apertiore bracteis foliaceis, pedicellis longioribus, corollis majoribus roseis profundioribus, capsulis majoribus differt. Fig. 2.

TYPE: Mexico, Sinaloa, Highway 40 (Mazatlán-Durango highway), 34.3 mi E of Concordia, growing with *Centaurium nudicaule* and *C. quitense* on wet roadbank with oak and pine above, 1770 m, 17 Feb 1971, C. R. Broome 763 (Holotype: DUKE; isotypes: K, MEXU, NY, UC, US).

Plants annual with erect, simple stems (8.5-) 12-25 (-43) cm tall, branched from above middle or sometimes from base. Leaves cauline, markedly decussate, green, not in a definite basal rosette but clustered at lower nodes and longer than the contracted internodes, becoming more remote upward and shorter than the elongated upper internodes; leaf-blades obovate or oblong, the lower (5-) 12-22 mm long, (2-) 5-8 mm wide, the margins upturned and becoming narrower, (ob-) lanceolate above with flattened margins. Inflorescence open, branches rather divaricate, these branched again only once or twice, monochasially or dichasially; pedicels 0.5-10 (-19) mm long. Flowers pentamerous, (1-) 5-30 per plant. Calyx 3-5.3 mm long, the lobes lance-acuminate with well-developed hyaline margins, 2.5-5 mm long, about equally the corolla-tube. Corolla salverform, rose-pink with white eye, (6-) 8-10 mm long; corolla-tube (3-) 5-7 mm long, not constricted above ovary; corolla-lobes 3.4-4 mm long, 1.7-2.3 mm broad with rounded and slightly erose tips. Stamens 2.5-3.6 mm long, inserted just below summit of ovary and equalling or exceeding the style; anthers oblong to sagittate, 1.2-1.8 mm long before dehiscence; pollen grains 20.9-29.4 μm in diameter. Ovary 4.2-5 mm long, bearing 2-3 rows of ovules on each carpel margin; style exerted from corolla-tube, 1.6-3 mm long, the stigma bilobed with the lobes flabellate. Capsule fusiform, 6.5-9 mm long, 1.8-3 mm broad; seeds ca 0.3 mm long, reddish-brown, ca 250 per capsule. Chromosome number: $n = 22$.

Known only from the Sierra Madre Occidental west of the summit of the high ridge of El Espinazo del Diablo along Mexico Highway 40, at ca 1600-2200 m, in Sinaloa and Durango, and one station in northern Nayarit. Moist, partly shaded steep clay banks of the oak-pine zone. Flowering specimens have been collected in February, March, and April.

Additional Collections: MEXICO. DURANGO: ca 2 mi SW of Revolcaderos enroute to Mazatlán on Hwy 40 on foot trail descending to rocky stream with oak-pine woods above, ca 2200 m, 26 Mar 1975, *Almeda 2529* (DUKE); along the Mazatlán-Durango highway 3-15 km toward El Salto from the Sinaloa boundary at El Palmito, 1950-2200 m, 13 Apr 1965, *McVaugh 23591* (MICH). SINALOA: Hwy 40 ca 4.7 mi N of El Carrizo in oak-pine forest zone at 1950 m, 26 Mar 1975, *Almeda 2526* (DUKE); dry hillside among pines and oak 49 mi E of Villa Union, 1630 m, 18 Mar 1955, *Wiggins 13179* (DS). NAYARIT: vicinity of Acaponeta, 9 Apr 1910, *Rose, Standley & Russell 14273* (F, GH, NY).

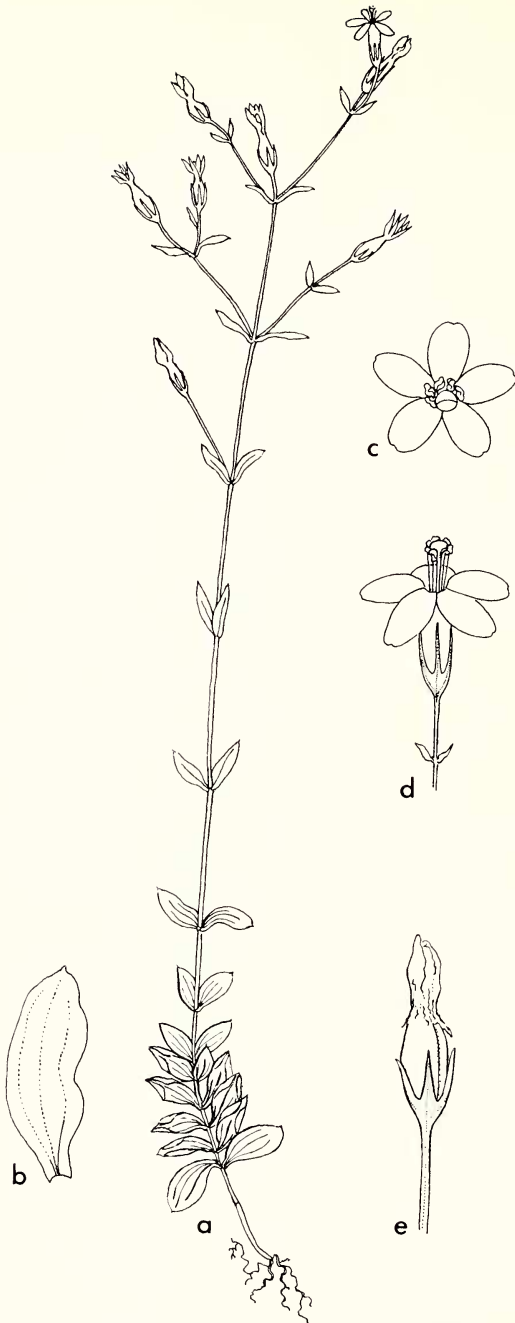


FIG. 2. *Centaurium wigginsii*. a. habit (x0.9), b. a lower leaf (x1.3), c. flower in top view (x2.5), d. flower in side view (x2.5), e. capsule with marcescent corolla (x2.5)—based on *Broome 763*.

The species is named for Professor Ira L. Wiggins, distinguished student of the Mexican flora, who made one of the earliest collections.

Centaurium wigginsii is related to *C. strictum*, a Mexican endemic found no farther north than Jalisco, in the Nueva Galicia region. The two species are quite similar in leaf morphology and habit, but differ significantly in the following characters:

	<i>C. wigginsii</i>	<i>C. strictum</i>
Branching angle	divaricate	strict
Inflorescence branches	with few inconspicuous bracts	conspicuously leafy
Pedice! of terminal flower	3.5-19 mm	1-6 mm
Corolla color	bright rose-pink	whitish to bluish or pale-pink
Corolla length	(6-) 8-10 mm	5-7.7 mm
Chromosome number	$n = 22$	$n = 21$

Experimental hybridization of several American species of *Centaurium* with *C. wigginsii* has confirmed that *C. strictum* is genetically similar as well (Broome, 1973). The F_1 hybrids in crosses between the two had up to 70% pollen stainability and produced vigorous F_2 's. Significant (defined as greater than 1% pollen stainability in the F_1 hybrid) affinities exist between *C. wigginsii* and only two other Mexican species as indicated by pollen stainability of the F_1 's: *C. quitense* (18-38%) and *C. nudicaule* (0.5-2.5%). It is my belief that *C. wigginsii* was derived directly from *C. strictum* by aneuploid increase, in the northernmost part of the range, followed by geographical isolation of the two species. *Centaurium wigginsii* is now sympatric with *C. nudicaule* in the same habitat, and is geographically but apparently not populationally sympatric with *C. setaceum* (Benth.) B. L. Robinson.

Centaurium capense Broome, sp. nov. Herba annua caule simplici, ramosissimo e basi, foliis caulinis anguste ovatis, floribus numerosis parvis roseis, lobis corollae tubo brevioribus, stigmatibus bilobis. *Centaurio floribundo*, *C. tenuifloro*, *C. pulchello* floribus similis, a his speciebus pedicellis longis, rosulis basalibus nullis, et ramificatione divaricata saepe trichotoma differt. Fig. 3.

TYPE: Mexico, Baja California Sur, along stream below Santiago, between Santiago and Rivera, Cape Region, 6 May 1931, *Wiggins 5665* (Holotype: US; isotypes: DS, F, GH, MICH, UC).

Plants annual with erect, simple stems 7.5-47 cm tall, branched at most nodes. Basal rosette of leaves lacking, but the lower internodes often contracted and the lower leaves clustered, the upper 3-6 cauline internodes to 63 mm long and often much longer than the subtending leaves. Leaf-blades thin, (ob-) lance-ovate to lanceolate, 12-32 mm long, 1.5-12 mm wide, the largest ones borne at the middle nodes of the stem, much reduced on lateral branches, the larger leaves with 5 main nerves. Inflo-

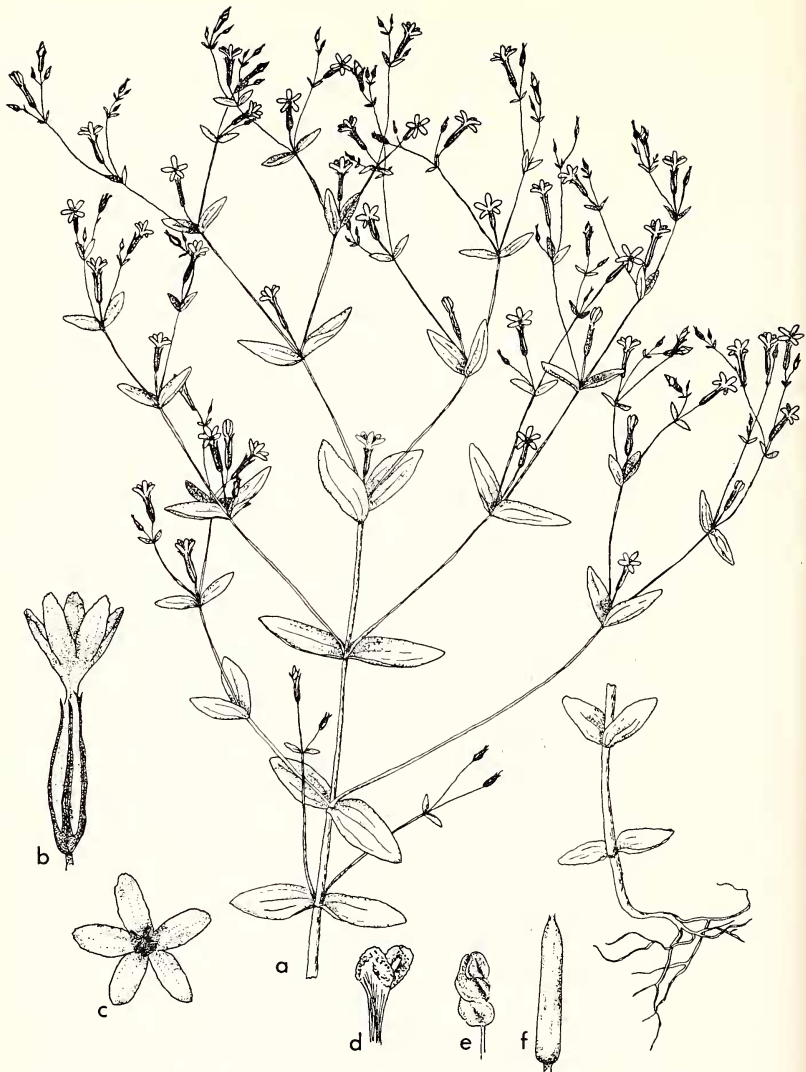


FIG. 3. *Centaurium capense*. a. habit (x0.5), b. flower in side view (x2), c. flower in top view (x2), d. style and stigma (x14.5), e. anther after dehiscence (x10.5), f. mature capsule, marcescent corolla removed (x2)—based on Wiggins 5608.

rescence a broad, divaricately branched compound cyme with the main branches arising from all but the lowermost one or two cauline nodes and diverging from the main axis at angles of 40–60°, these branched again 3–4 times, the branching mainly monochasial but with a high frequency of dichasial (trichotomous) branching at all levels; pedicels of central flowers in dichasia 5–20 mm long, usually shorter than the flowers but slightly longer on lateral flowers. Flowers pentamerous, 50 to several

hundred per plant. Calyx 5.5–10 mm long, the lobes 5–10 mm long, filiform, shorter than the corolla-tube, with inconspicuous hyaline margins. Corolla light to deep pink with small white eye, (9–) 10–16 mm long; corolla-tube (6–) 7–12.5 mm long, exceeding ovary by ca 2 mm and slightly constricted above it; corolla-lobes 3–4.7 mm long, 1–2 mm wide, lanceolate with blunt and minutely erose tips. Stamens inserted just above summit of ovary, exceeding style; anthers oblong, 0.7–1.5 mm long after anthesis, frequently bent over on filaments and shedding pollen directly onto stigma beneath; pollen grains 21.8–28.5 μm in diameter. Ovary 5.2–8.5 mm long, ca 1 mm wide, bearing 2–3 rows of ovules on each carpel margin; style included or slightly exerted from corolla-tube, deeply divided with stigma-lobes ovoid, longer than broad. Capsule narrowly cylindrical, 9–11 (–12.5) mm long, 1.5–2 mm broad; seeds 0.15–0.2 mm long, deep reddish-brown.

Known from Baja California Sur only in the Cape Region in the Lagunan Woodland biome (Axelrod, 1958) of the mountains just southeast of La Paz and southward. In moist, sandy soil along streams and in washes. Flowering specimens have been collected from March through early May.

Additional Specimens: MEXICO. BAJA CALIFORNIA SUR: 22 mi S of La Paz, 8 May 1931, *Wiggins 5608* (DS); La Huerta, 19 May 1889, *Brandege s.n.* (UC); ca 6 mi SW from Santiago, Arroyo San Mateo, 30 Apr 1959, *Thomas 7722* (DS); along stream below Santiago between Rivera and Santiago, 6 May 1931, *Wiggins 5660B* (DS); Santiago, 31 Mar 1936, *Bailey 176* (F); El Reparito, S fork of Cañon San Pedro, ca 770 m, 23°20'N, 109°55'W, 8 May 1959, *Moran 7361* (DS); Arroyo Culebriado near junction of trails to Rancho la Frágua and Rancho Sauce (SE of Cerro Giganta), ca 400 m, 26°3.5'N, 111°28.5'W, 31 Mar 1960, *Carter & Ferris 4065* (UC); Arroyo del Salto, E of La Paz, in moist granitic sand under palms, 24°12'N, 110°7.5'W, 30 Mar 1949, *Carter 2576* (UC); San José del Cabo, 2 Apr 1892, *Brandege s.n.* (UC); San Lazaro Canyon, ca 100 m, 23°08'N, 109°48'W, 2 May 1959 *Moran 7329* (DS); Potrero de Almenta, Arroyo de Almenta, E slope of Sierra de la Victoria inland from Caduano, 1036 m, 9–11 May 1959, *Thomas 7825* (DS, GH, US).

This interesting species has been distributed as *Centaurium exaltatum* (Griseb) W. F. Wight or as *C. nudicaule*, two other small-flowered species which also occur on the Baja California peninsula. On closer inspection, the new species was found to differ from those taxa in several characters:

	<i>C. exaltatum</i>	<i>C. capense</i>	<i>C. nudicaule</i>
Stigma lobe shape	flabelliform or reniform	ovoid	flabelliform
Style division	shallow	deep	shallow
Corolla length	10–19 mm	10–16 mm	6.5–10 mm
Capsule length	10–15 mm	9–12.5 mm	6–9.5 mm
Capsule width	1.8–3.5 mm	1.5–2 mm	1.2–3 mm
Cauline leaf shape	lanceolate	lance-ovate to lanceolate	linear or subulate

Type of cyme	narrow, rather strict	broad divaricate	narrow, branches ascending
Central pedicel	longer than flower	shorter than flower	longer than flower

The origins of this species are obscure. My initial hypothesis that this endemic was derived from migrant populations of *Centaurium exaltatum* has been rejected on morphological grounds. The style is unusual as it is distinctly branched beneath the papillose surface of the stigma lobes. The lobes are devoid of papillae in the central portion of the inside surface. These are features found, to my knowledge, only in those species allied to *C. minus* Moench, including the California taxon, *C. floribundum* (Benth.) B. L. Robinson. Besides *C. floribundum* and *C. capense*, no other American species have been found to have this stylar morphology. The very narrowly cylindrical ovary and capsule of both species also ally them to *C. minus*. *Centaurium capense*, like *C. floribundum*, in all probability has its closest relatives in Europe or Asia.

ACKNOWLEDGMENTS

This paper is based on a portion of a dissertation submitted to the faculty of Duke University in partial fulfillment of the doctoral degree. I wish to acknowledge the support of National Science Foundation Systematics Training grants GB-6393 and GB-23200 during this research. The illustrations were prepared by Karen Teramura (Fig. 1), Susan Carlton Smith (Fig. 2), and Lyn Loveless (Fig. 3). My thanks to the curators of the following herbaria for allowing me to study their material: DS, DUKE, F, GH, K, MEXU, MICH, NY, TEX, UC, US.

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